Teachers Field Trip

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Earth History Field Trip
for High School Science Teachers
Stockton, Illinois. May 15, 1948

Sponsored by State Geological Survey
M. M. Leighton, Chief
Gilbert O. Raasch, Conference Director
Principal W. R. Holloway, Conference Host

General Instructions:

1. Please be prepared to leave promptly at 9:00 a.m., Central Standard Time.

2. Cars will assemble at Stockton High School.

3. Participants will provide themselves with lunches before starting.

4. At scheduled stops, please assemble promptly near leader to hear his discussion before scattering for individual examination of points of interest; also please be prompt to leave upon signal. This is especially desirable if the group is large.

Instructions for Car Drivers:

To expedite the trip and for safety, please

1. Identify your car by attaching one of the tags provided.
2. Have your car in line before the trip starts.
3. Follow carefully and keep fairly close to the car ahead, with due regard to safety.
4. Keep all gaps in the caravan closed, especially while traveling through the city, in order to prevent other cars from inserting themselves in the caravan or crossing the caravan at intersections.
5. Watch the cars ahead and behind for signals.
6. Keep your place in the caravan as far as possible; do not attempt to pass ahead of any in the caravan unless they drop out of line, nor to gain an advanced position at stops.
7. If for accident or other reason you drop out of line, let those following you proceed, except for such help as may bee needed; in case of accident to the rear car of the caravan, signal those ahead.
8. Any car dropping out of line shall take up the rear when rejoining the caravan.
9. When parking in line at stops, draw close to the car ahead; when parking parallel, do not leave unnecessary space between cars.
10. One passenger in each car, preferably sitting beside the driver, should read the itinerary and keep the driver adequately informed with regard to stops, turns, etc.

PART II - ITINERARY

0.0 Caravan assembles facing south on west side of street in front of school.

0.1 Turn right (W) two blocks.

0.2 Turn right (N).

0.4 Park below city reservoir.
STOP I. Go to top of hill at reservoir. Elevation here is 1112 feet above sea level. Knob to west is capped by Silurian Dolomite but reservoir hill is capped by dolomite layer slightly lower down, in Ordovician, Maquoketa Formation. Fossils of Maquoketa age are present.

View west is across upland of Ordovician, Maquoketa shale, which is dissected by steep-sided valleys that cut down into Ordovician, Galena Dolomite (see Geologic column). To south, line of high hills is Silurian ("Niagara") Escarpment. To north in foreground is Benton Mound, an outlier of Silurian Dolomite left behind when the escarpment retreated southward under the action of erosion.

Reservoir Hill is outside the limit of glaciation. During the Illinoian Stage of glaciation, the continental ice sheet stood just to the east, and the ice front extended in a fairly straight line north and south from Stockton. The extent of the ice sheet can be traced today by the presence of pebbles and boulders of rock types foreign to the region, some of them carried down by the ice mass from as far north as Canada.

0.4 Turn right (E).

0.6 Main St. Turn left (N).

0.8 Turn right (E) on Summit Ave.

0.9 STOP II. House excavation exposed yellow till of Illinoian glaciation, leached and weathered, with some pebbles of igneous and metamorphic rocks which do not outcrop south of the Lake Superior Region and Ontario. Till is unsorted glacial material, ranging in size from fine clay to large boulders. This material was left behind when the glacier melted away.

1.1 Turn left (N).

1.2 Caution. Cross U. S. Highway No. 20, and continue ahead (N). For 3 miles, route passes along edge of glaciated area, but the valley of the creek to the west is outside the glacial limit. This creek once carried the waters from the melting ice.

4.4 Turn left (W).

5.5 STOP III. Quarry in Ordovician, Galena Dolomite. This is high in the Galena Formation and is the Stewartville Member, characterized by lack of chert and moderately thick, even layers. Moulds of fossil shells, chiefly gastropods ("snails") occur sparsely. The rock is being quarried for agricultural limestone and for road macadam.

6.5-6.6 Road jogs left, then right.

7.0 STOP IV. Hill rising above road to south is north end of Benton Mound, here 1180 feet high. (1/2 mile SE it rises above 1220 feet) It is capped by Silurian Dolomite.

To north we look down on a very flat upland cut in the Maquoketa Shale. This upland was once the divide between streams which drained into the Pecatonica to the east and streams which drained directly into the Mississippi to the west.

However, when the Illinoian Glacier stood just 2 1/2 miles east of here, it blocked the eastward flowing streams. First, they backed up and formed a lake in the valley to the right. Eventually this lake filled and spilled over the divide into the westward flowing streams. This outlet was along the present course of Apple River Canyon which was cut 200 feet deep, down through solid rock by these glacial torrents. That is why the South Fork of Apple River, which once flowed Southeast, today flows Northwest.

7.1 Turn right (N) and go north to Apple River State Park.

10.5 Enter Apple River State Park. Road descends from Maquoketa Upland through ravine cut in Galena Dolomite.

10.7 STOP V. Apple River Parking Area. Walk west to foot bridge, cross Apple River, and take trail ascending bluff. Cliffs are in Galena Dolomite. Near summit of trail it is easy to trace the original valley which flowed southeast and is now occupied by North Fork on the left and by South Fork on the right. When the Illinoian Ice Sheet dammed South Fork near Stockton, the waters cut their way to the Mississippi by carving out the deep canyon. Go to top of bluff and a short distance south to observe the canyon's depth. It is 200 feet deep, nearly straight in a NE-SW direction, and over 4 miles long. Except at its upper and lower ends it is inaccessible except on foot.

10.7 LUNCH STOP on site of old Millville.

10.7 Leave parking area, cross bridge, and immediately turn left (W).

10.9 Cross North Fork of Apple River and ascend steep hill.

11.8 Quarry in Stewartville Dolomite of Galena Formation on right. Some layers have numerous molds of brachiopod shells.

12.4 STOP VI. The mound to north is capped by Silurian Dolomite. Road is on flat Maquoketa Upland which stretches as a level plateau southeast to Benton Mound. Between ovserver and Benton Mound, the deep canyon of Apple River is hidden from view, except as indicated by projecting tree tops.

13.0 Turn right (N).

14.7 Cross North Fork of Apple River. Note how much shallower valley is here than in the park.

16.9 Caution. Junction with County Highway at SE edge of Apple River Village. Continue on County Highway and turn left (W) through Apple River.

18.9 Cross Apple River, here a shallow valley not affected by glacial influences.

20.5 STOP VII. East end of deep cut of I.C.R.R. Rock from cut has been piled along right-of-way to east.

Cut is in about 25 feet of beds from the middle portion of the Maquoketa Shale. These are shales, siltstones, and impure limestones containing fossil trilobites (Isotelus), cephalopods (Orthoceras sociale), gastropods (Liospira), graptolites (few), and shiny-shelled brachiopods related to modern Lingula and Discina. Note definite, even stratification, typical of sediments deposited in quiet water.

20.8 Turn right (N) and cross R.R. on wooden overpass.

21.1 Road turns left (W).

22.7 Road turns left (S).

22.8 Road junction; turn right (W).

24.4 STOP VIII, on Charles Mound, which rises to a crest of 1241' a mile W. NW. This is less conspicuous than many surrounding hills because it rises from a high plateau of the Maquoketa Formation; the mound is capped by Silurian dolomite. To south, the Silurian (Niagara) Escarpment is clearly shown; higher hills to north are in Wisconsin.

A short distance down the road to the south (left), blue clays with irregular layers of limestone full of fossils are present in road ditch. These beds lie near the top of the Maquoketa Formation. Flat brachiopod shells (Rafinesquina and Strophomena) are most conspicuous.

24.4 Turn left (S).

25.2 Turn right (W).

26.2 Turn left (S).

26.7 Road turns right (W).

27.3 Turn left (S) and enter Scales Mound Village.

27.6 Cross overpass over I.C.R.R.

27.6 STOP IX. Park South of overpass along main street. Walk west along R.R. tracks to deep rock cut. Here may be seen the contact between dark gray shale of Maquoketa Formation above and rough-weathering buff dolomite of the Galena Formation below. Immediately above the dolomite and again a foot higher may be seen two soft rusty bands. These contain tiny pelecypods or clams (Ctenodonta fecunda) and snails (Liospira Micula) not found at any other stratigraphic level in the region. Because of these dwarf fossil shells, geologists refer to these beds as the "depauperate zone." Graptolites, an extinct group of sea animals supposedly related to corals, are said to occur in the shale above the "depauperate zone."

Note how rock grades upward into residual soil.

27.6 Continue ahead (S).

28.3 Turn right (W) at highway junction.

28.6 Outcrop in roadcut is silty dolomite of Maquoketa Formation.

..4 STOP XI, at highway junction. Ascend Scales Mound. Highest rock on mound is cherty Silurian Dolomite of Kankakee Formation. Numerous small marine fossils and the honeycomb coral Favosites occur in this rock.

Note how huge blocks of the dolomite have slumped down the sides of the bluff due to the weathering away of the soft Maquoketa Shale which underlies the dolomite (the same blue shale zone as seen at Charles Mound).

On a clear day, a remarkable view of the surrounding region can be gained from this point. Once again, the Silurian Escarpment is near at hand to the south. Far to the west, across the Mississippi River in Iowa, the escarpment can be seen holding a southeast-northwest alinement. Scales Mound is an outlier of this Silurian (Niagara) Escarpment. Other famous outliers may be seen, such as Sinsinawa Mound many miles nearly due west, across the Wisconsin line; also far to the north, the Platte Mounds, 1420 feet high and 20 miles away, The most famous outlier of all, the northermost and highest (1716 feet), Blue Mounds lies northeast beyond the Wisconsin horizon. These outliers tell us that the Silurian sea extended far beyond the present Silurian escarpment.

In the near distance, to the west, the Maquoketa upland is broken by valleys deeply cut down into the Galena Dolomite, which here bears rich deposits of lead and zinc ore.

The day's conference clearly shows how the bedrock controls the topography of the region, with the Galena and Silurian Dolomites making steep slopes or cliffs and the softer, shaly Maquoketa Formation, making nearly flat broad terraces. Throughout the region, however, the highest hills, regardless of the rock composing them, all rise from 1100 to 1200 feet high. These crests are believed to be remnants of what was once a continuous plain (or peneplain) formed when the region lay about 1000 feet lower than it does today. At that time, long-acting erosion had cut away still higher hills and reduced the region to this plain surface. Later, the region was again uplifted and erosion is actively cutting it down and dissecting it into a maze of narrow ridges and deep valleys. If nothing intervenes, in time a new peneplain will be formed, but little above the level of the Mississippi.

This region preserves this long erosional history because it was never covered by glacial ice, which left a thick blanket of glacial drift over most of the rest of Illinois. This unglaciated region, entirely surrounded by glaciated country is world-famous as "The Driftless Area."

END OF CONFERENCE - BON VOYAGE!

Note: The left fork at the base of the mound continues SW for 3 miles as a beautiful "skyline drive" and passes through attractive country to Galena.

GENERALIZED GEOLOGIC COLUMN FOR EASTERN JO DAVIESS COUNTY

Prepared by the Illinois State Geological Survey

ERAS		PERIODS	EPOCHS	REMARKS
Cenozoic "Recent Life" (Age of mammals)		Quaternary	Pleistocene	Illinoian glacial drift along east edge of county. Loess deposits on upland & alluvium in river valleys.
		Tertiary	Pleiocene Miocene Oligocene Eocene Paleocene	Not present in Jo Daviess County.
Mesozoic "Middle Life" (Age of Reptiles)		Cretaceous		Present only in extreme southern Illinois.
		Jurassic		Not present in Illinois.
		Triassic		Not present in Illinois.
Paleozoic "Ancient Life"	Amphibians Early Plants	Permian		Not present in Illinois.
		Pennsylvanian		Not present in Jo Daviess County.
		Mississippian		Not present in Jo Daviess County.
	Age of Fishes	Devonian		Not present in Jo Daviess County.
	Age of Invertebrates	Silurian	Cayugan	Not present in this area.
			Niagaran	Present only on highest mounds south and west of trip area.
			Alexandrian	Kankakee cherty dolomite Edgewood thin-bedded earthy dolomite.
		Ordovician	Cincinnatian	Maquoketa shale and shaly limestone.
			Mohawkian	Galena dolomite - in outcrop Decorah shale Platteville ls. Glenwood ss. } in wells
			Chazyan	St. Peter ss. - in wells.
			Prairie du Chien	Shakopee dolomite New Richmond ss. Oneota dolomite } in wells
		Cambrian		In deep wells only.
Proterozoic Archeozoic		Referred to as "Pre-Cambrian" time.		No data available.

May, 1948 R.W.E.

PART IV

GEOLOGICAL HISTORY OF APPLE RIVER AREA

DEEPLY BURIED FORMATIONS

The oldest bedrock that comes to the surface in eastern Jo Daviess County is the Galena Dolomite of Ordovician Age (see geologic column, Part III). Deep wells drilled over 1500 feet deep at Galena and nearly 1300 feet deep at Stockton show older rocks lying at lower levels. Beneath the Galena Dolomite, lies the Platteville Limestone, underlain by the St. Peter Sandstone, that in turn by the Prairie du Chien Formation. All these are still of Ordovician Age, but older than the Galena. They come to the surface farther north in Wisconsin and east in Central Illinois.

Beneath these older Ordovician rocks are still older layers of sandstone and dolomite over 1000 feet thick that belong to the Cambrian Period. Wells in Jo Daviess County do not penetrate below the Cambrian strata, but in adjoining regions crystalline rocks such as granite, basalt, or gniess and/or dark red sandstones of Pre-Cambrian age are present. These oldest rocks of all are deeply buried everywhere in Illinois but come to the surface in Central Wisconsin and northward to the region of Hudson Bay.

EXPOSED FORMATIONS - Galena Dolomite.

A dolomite is a limestone having a part of the usual calcium replaced by magnesium. Nearly 250 feet of such rock is present in the area, and this thickness can be subdivided into several members which have been given geographic names. Those exposed in the field trip area are, from top downward, as follows:

Dubuque Member
Stewartville Member
Prosser Member.

The uppermost or Dubuque Member is about 30 feet thick and characterized by thin bedding, with dolomite layers separated by shaly layers. Fossils are rather common, notably a Lingula-like brachiopod, Lingulasma iowensis.

Below the Dubuque Member a somewhat greater thickness of thicker bedded, bluish gray, buff weathering dolomite without chert is characterized by several species of large gastropods (snails). This is the Stewartville Member.

The main mass of the Galena Formation (Prosser Member) is a thick-bedded unit of dolomite layers some of which bear abundant white chert. There are two zones of the large and striking "sun-flower coral" which is really an archaic type of sponge called Receptaculites oweni. The Prosser dolomite weathers into rough ledges and breaks down under weathering agencies to a dolomite sand. Because of its ready solubility, this unit is the rock in which many caves have been formed in adjoining areas.

The Galena Formation is important in the western part of the county and in adjoining parts of Wisconsin and Iowa for the valuable lead and zinc deposits which it contains. These are not discussed at this time, as the present trip does not include the mining region.

Maquoketa Formation

Above the Galena Dolomite lies an irregular thickness of shale and shaly limestone, the Maquoketa Formation. Like the Galena Formation, the Maquoketa can be subdivided into anumber of members, but these subdivisions have not yet been published for the area. The lower part of the formation is a soft, dark shale with one or more layers of rusty punky shale full of minute mollusks and phosphate pellets. The middle part of the formation is made up of thin layers of earthy brown dolomite and tan to dark gray shale. Fossil trilobites, phosphatic shelled brachopods and other fossils occur here. The upper part of the formation is mainly soft blue clay with irregular thin limestone bands jammed with fossil brachiopods and bryozoa.

Sometimes this upper zone is thin or missing because of erosion which took place after the shale was deposited but before the next overlying Silurian dolomites were laid down. This is evidence of a land interval between the time when the sea withdrew after depositing the Maquoketa shale and reappeared again in Silurian Time.

Hundreds of feet of Silurian dolomite were deposited over all of northern Illinois, but in the Apple River area most of this dolomite has been stripped away by erosion since that time. Today only thin remnants of the lower part of this dolomite remain as cap rock on the higher hills.

The lower 50 feet of the Silurian Dolomite can be divided into two formations, the Edgewood Member below and the Kankakee above. The Edgewood fills irregularities in the uneven top of the Maquoketa Formation, and therefore varies a good deal as to character and thickness. Where seen on the trip it is thin-bedded, almost shaly and without chert. The overlying Kankakee has somewhat thicker beds, without shale, and full of chert in white bands containing the coral Favosites and numerous other small fossils.

EARLY GEOLOGIC HISTORY

After Pre-Cambrian time, when the most ancient "basement" rocks were formed, folded, and then worn down to a nearly level plain, the Apple River area was almost continuously covered by the waters of inland seas down through the later part of the Cambrian, the Ordovician, much of the Silurian, and a part of the Devonian periods. There is even possibility that the Mississippian and Pennsylvanian seas, so prominent farther south in the State, extended over this area, - but here evidence is lacking.

Om the other hand, since Pennsylvanian time at least, there is no reason to believe that the sea ever returned to this area, which remained dry land at moderate elevations above the sea. Except for a broad, gentle arching which took place before Pennsylvanian time and had its apex in central Wisconsin, the rock layers were at no time seriously disturbed. Through the hundreds of millions of years which make up Mesozoic and Tertiary time, weathering by the atmosphere and erosion by streams have combined to wear away many hundreds of feet of strata which once overlay this region. It is these forces that carved the landscape to its present pattern of hills and ridges. In the course of this wearing down, the harder Galena and Silurian dolomites resisted erosion more successfully than did the intervening Maquoketa shales. Therefore, the two

dolomites form cliffs or steep slopes, while the shales form broad gently rolling terraces. Where limestone layers are present in the Maquoketa Formation, they tend to form small knolls as a result of the protection of this limestone cap-rock.

ICE AGE HISTORY

During the Ice Age (Pleistocene), continental glaciers descended from northern Canada across northern United States, not once, but four times. Between these periods of glaciation were intervals of mild climate lasting from one to several hundred thousand years. During these intervals, the ice melted away, vegetation flourished and formed soils, and strange or foreign animals roamed the landscape.

Beginning with the earliest, the four glacial divisions of the Pleistocene are as follows: Nebraskan, Kansan, Illinoian, Wisconsin.

Most of Jo Daviess County was never glaciated at all. Yet go any direction from the County, and you will sooner or later pass into glaciated country. This is because Jo Daviess County is part of the famous "Driftless Area," the bulk of which lies to the north, in southwestern Wisconsin.

This Driftless Area is rather an accidental gap in the glacial coverage of the four stages of glaciation. Two of the continental glaciers, the earliest or Nebraskan and the latest or Wisconsin never reached the boundaries of the county. The Kansan Glacier, advancing from the northwest, barely touched the west edge of the county, whereas the Illinoian Glacier, advancing from the northeast, stopped a few miles inside the eastern border of the county.

The prominent physiographic features such as moraines, kames, eskers, etc., generally associated with glacial deposits are not apparent in this region. The glacial till dropped by the melting of the Illinoian Ice Sheet is rather similar in superficial appearance to the normal residual soils of the region, except for the fact that it contains some pebbles of crystalline rocks which must have been carried down from the far north. This suggests that the glacier did not erode deeply in the Apple River area, but limited its activity to a scaping of the locally weathered material from the bedrock surface. This material it spread in an even blanket which reduced the original irregularities of the region, so that today the glaciated area has a much more subdued landscape than that of the rugged driftless area to the west of the glacial limit.

A special feature of the local glacial geology, the diversion of the headwaters of Apple River and formation of a temporary lake, are discussed in the Itinerary (Part II).

Suggested Reading

A comprehensive, detailed, and well illustrated account of the geology of Jo Daviess County is presented in Trowbridge and Shaw's "Geology and Geography of the Galena and Elizabeth Quadrangles." This Bulletin No. 26 of the Illinois State Geological Survey (Urbana) is still available for a fee of 50 cents (free to schools). A part of this same material has also been published by the U. S. Geological Survey as Folio No. 200.

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Reorder No. 1112-1/3

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HEAVY WEIGHT